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**Original Research Article**

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**Role of supplemental oxygen in reducing surgical site infection in acute appendicitis: Our experience of sixty four cases**

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E-mail: [yijugunnu@gmail.com](mailto:yijugunnu@gmail.com)**Abstract**

**Aim:** To assess whether use of 80% oxygen reduces the frequency of surgical site infection in patients undergoing open appendectomy for appendicitis.

**Material & Methods:** A randomised control study was conducted in the department of general surgery at NKP Salve Institute of Medical Sciences & Research Center & Lata Mangeshkar Hospital Nagpur. Sixty four patients undergoing open appendectomy via incision in the right lower quadrant of the abdomen were divided randomly into study group ie. patients receiving 80% oxygen during anesthesia, followed by high-flow oxygen for 2 hours in the recovery room and the control group receiving 30% oxygen, as usual. Surgical site infection will be assessed by the ASEPSIS (additional treatment, serous discharge, erythema, purulent discharge, separation of deep tissues, isolation of bacteria, and stay in hospital prolonged >14 days) system score. SPSS statistical software version 16.0 was used for data analysis.

**Results:** The age distribution between the study and control group was statistically similar with  $p = 0.627$ . The sex distribution between the study and control group was statistically similar with  $p = 0.157$ . There were no medical comorbidities seen in both groups. The body temperature distribution between the study [mean  $\pm$ SD =  $37.02 \pm 0.12$ ] and control [mean  $\pm$ SD =  $37.06(0.24)$ ] group was statistically similar with  $p = 0.272$ . Duration of abdominal pain was not significant with  $p=0.596$ . Preoperative analysis like WBC count, abdominal tenderness, Abdominal rigidity, hemoglobin, serum creatinine, blood urea, USG abdomen distribution was statistically not significant with  $p$  value  $>0.05$ . Duration of operation distribution between the groups was not significant with  $p=0.874$ . There was no surgical site infection seen in study as well as control group. All the cases in study as well as control group have satisfactory healing. There was significant ( $p=0.003$ ) longer hospital stay in control group.

**Conclusion:** Our study concludes that there is no role of supplemental oxygen in reducing surgical site infection in acute appendicitis.

**Keywords:** Acute appendicitis, hyper oxygenation, surgical site infection

**1.Introduction**

Surgical site infections (SSI) result in significant morbidity, delayed hospital discharge and increased healthcare costs. There is a known association between SSI and hypoperfusion, contaminated wounds, perioperative hyperglycaemia and hypothermia and obesity [1]. It has long been proposed that the use of perioperative hyperoxia to high risk patients may result in a reduction in the risk

of SSIs. The converse argument is that hyperoxia is toxic to the lungs and results in increased atelectasis and, potentially, an increase in postoperative pulmonary complications [2][4].

The scientific rationale for preoperative hyperoxia is that oxidative killing by neutrophils, the primary defence against surgical pathogens, depends critically on tissue oxygenation.[5] Hopf and

colleagues performed a non interventional, prospective study of subcutaneous wound oxygen tension (PsqO) and its relationship to the development of wound infection in surgical patients[6]. One hundred and thirty general surgical patients were enrolled and PsqO was measured perioperatively. There was an inverse relationship between wound oxygen tension and the risk of developing surgical site infections (SSI). They hypothesized that manipulating FiO may increase PsqO and reduce SSIs.

Belda et al[7] undertook a double-blind, randomized controlled trial of 300 patients aged 18 to 80 years who underwent elective colorectal surgery. The risk of SSI was 39% lower in the 80% FIO group (relative risk [RR], 0.61; 95% confidence interval [CI], 0.38-0.98) vs the 30% FIO group. After adjustment for important covariates, the RR of infection in patients administered supplemental oxygen was 0.46 (95% CI, 0.22-0.95;  $P = .04$ ). Similar results were reported by Bickel and colleagues[8], in a 210 patients with acute appendicitis.

## 2. Material & Methods

A randomised control study was conducted in the department of general surgery at NKP Salve Institute of Medical Sciences & Research Center & Lata Mangeshkar Hospital Nagpur. Sixty four patients undergoing open appendectomy via incision in the right lower quadrant of the abdomen were divided randomly into study group ie. patients receiving 80% oxygen during anesthesia, followed by high-flow oxygen for 2 hours in the recovery room and the control group receiving 30% oxygen, as usual. Surgical site infection was assessed by the ASEPSIS (additional treatment, serous discharge, erythema, purulent discharge, separation of deep tissues, isolation of bacteria, and stay in hospital prolonged >14 days) system score. SPSS statistical software version 16.0 was used for data analysis.  $P$  value < 0.05 considered as significant.

## 3. Results

The age distribution between the study and control group was statistically similar with  $p = 0.627$ . (Table 1)

**Table 1: Age distribution**

Age	study	control	P value
Mean (SD)	27.15(10.46)	28.56(12.22)	0.627 <sup>b</sup>
Range	55-13	60-15	

b- by t test

The sex distribution between the study and control group was statistically similar with  $p = 0.157$ . (Table 2)

**Table 2: Sex Distribution**

Sex	Study	Control	P value
Male (%)	22(73.3)	18(56.2)	0.157 <sup>a</sup>
Female (%)	10(31.2)	14(43.7)	
Total	32	32	

a- by Chi square test.

There were no medical comorbidities seen in both groups. (Table 3)

**Table 3: Medical comorbidities**

Medical background	Study	Control	P value
Ischemic heart disease	0	0	-
Hypertension	0	0	-
Diabetes	0	0	-
Pulmonary disease	0	0	-
Inflammatory bowel disease	0	0	-

The body temperature distribution between the study [mean  $\pm$ SD = 37.02 $\pm$ 0.12] and control [mean  $\pm$ SD = 37.06(0.24)] group was statistically similar with  $p = 0.272$ . (Table 4)

**Table 4: Body temperature**

Body temp. °C	study	control	P value
Mean (SD)	37.02(0.12)	37.06(0.24)	0.272 <sup>b</sup>
Range	37.7-37	38.3-37	

b- by t test

Duration of abdominal pain was not significant with  $p=0.596$ . (Table 5)

**Table 5: Duration of Abdominal pain:**

Duration of abdominal pain	study	control	P value
Mean (SD)	2.84(2.91)	3.18(2.30)	0.596 <sup>b</sup>
Range	10-1	8-1	

b- by t test

Preoperative analysis like WBC count, abdominal tenderness, Abdominal rigidity, hemoglobin, serum creatinine, blood urea, USG abdomen distribution was statistically not significant with  $p$  value >0.05. (Table 6)

**Table 6: Preoperative analysis**

WBC count /uL	study	control	P value
Mean (SD)	9328.12 (2919.15)	9846.8 (2914.36)	0.517 <sup>b</sup>
Range	18000-4300	14800-4200	
Abdominal tenderness	100	100	-
Abdominal Rigidity %	15.6	15.6	-
Hemoglobin Mean (SD)	12.03 (1.74)	12.19 (1.66)	0.729 <sup>b</sup>
Serum Creatinine Mean (SD)	0.923 (0.187)	0.924 (0.20)	0.975 <sup>b</sup>
Blood urea Mean (SD)	24.26 (6.84)	26.95 (6.56)	0.146 <sup>b</sup>
Imaging (Ultrasound abdomen)%	71.8	87.5	0.157 <sup>a</sup>

a- by Chi square test, b- by t test

Duration of operation distribution between the groups was not significant with  $p=0.874$ . (Table 7)

**Table 7: Duration of operation & Intraoperative findings**

Duration of operation (min)	Study	control	P value
Mean (SD)	61.87 (10.6)	61.4 (12.5)	0.874 <sup>b</sup>
Range	120-60	90-60	
Intraoperative findings			
1. Normal appendix	0	0	-
2. Acute appendicitis	32	32	-
3. Phlegmonous appendicitis	0	0	-
4. Gangrenous appendicitis	0	0	-

b- by t test

There was no surgical site infection seen in study as well as control group. All the cases in study as well as control group have satisfactory healing. There was significant ( $p=0.003$ ) longer hospital stay in control group. (Table 8,9 &10)

**Table 8: Post operative sequelae**

Post operative sequelae	Study	Control	P value
Length of hospital stay (days)	7.37 (3.57)	9.84 (3.68)	0.003 <sup>b</sup>
Wound infection	0	0	-

b- by t test

**Table 9: ASEPSIS SCORE**

Wound healing	Study	Control	P value
Satisfactory healing	32	32	-
Disturbance of healing	0	0	-
Minor wound infection	0	0	-
Moderate wound infection	0	0	-
Severe wound infection	0	0	-
Wound exploration	0	0	-

**Table 10: Histopathology**

Histopathology	study	control
Acute appendicitis	32	32

#### 4. Discussion

Our data does not reveal any significance of supplemental oxygen in reducing surgical site infection in acute appendicitis. The prophylactic antibiotic ceftriaxone was given to all the patients at the time of skin incision and was continued for 3 postoperative days. The operative site is checked on post op day 3. Then the patient was given oral antibiotic (cefixime) for 5 days. Suture was removed at 7-10<sup>th</sup> post operative days. The wound was checked at regular interval by a senior surgeon blinded to study and control group. ASEPSIS scoring

method was used to assess the degree of healing and infection of the surgical wound.

Wilson et al[9] and Byrne et al[10] suggested ASEPSIS scoring method is considered to be an objective, reliable, and reproducible method of surgical wound assessment, making it applicable to all forms of surgery and takes into account a large multidimensional number of easily made assessments for final classification.

If we go through the literature the role of supplemental oxygen on SSI are controversial, and the reasons are most likely multifactorial.[11][13] We knew that ability of the neutrophil to eradicate bacteria is mediated by its oxidative killing capabilities, depending on the creation of bactericidal superoxide radicals from molecular oxygen.[6][14] Recent studies have demonstrated a beneficial influence of hyperoxia by hyperbaric oxygen in diverse models of ischemia-reperfusion, protecting against oxidative stress.[15][18]

The parameters in our study like age, sex, clinical data on admission, pre preparative data and duration of operation was statistically insignificant. Most of the operations were performed by residents under the supervision of the consultants. All the cases have intraoperative finding of acute appendicitis and no features of complicated appendix like phlegmon, gangrenous and perforated appendix. This was again confirmed on Histopathology of the specimen.

Studies mentioned earlier have demonstrated, increase incidence of surgical site infection in cases of complicated appendicitis like phlegmon, gangrenous and perforated appendix. This may be the reason why our patients have no surgical site infection as all the patients have intraoperative feature of acute appendicitis.

Our study reveals longer hospital stay in case of control group and in some cases in study group with statistically significant p value. Our hospital is a rural based tertiary care center with major drainage of patients from rural areas. Financial concern as well as administrative concern may be the reason for longer stay of these patients in hospital.

#### 5. Conclusion

Our study concludes that there is no role of supplemental oxygen in reducing surgical site infection in acute appendicitis.

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